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271. Proposed by E. B. ESCOTT, Ann Arbor, Mich.

In the differential equation

$$\left(\frac{d^2y}{dx^2}\right)^2 \frac{d^5y}{dx^5} - 5\left(\frac{d^2y}{dx^2}\right) \frac{d^3y}{dx^3} \frac{d^4y}{dx^4} + \frac{40}{9} \left(\frac{d^3y}{dx^3}\right)^2 = 0,$$

show that there is an integrating factor of the form $\left(\frac{d^2y}{dx^2}\right)^n$, and integrate the equation.

Solution by the PROPOSER, and LEVI S. SHIVELY, Mt. Morris College, Mt. Morris, Ill.

When the equation is multiplied by $(d^2y/dx^2)^n$, if it is an exact equation, its first integral is

$$\left(\frac{d^2y}{dx^2}\right)^{n+2} \frac{d^4y}{dx^4} + \frac{40}{9(n+1)} \left(\frac{d^2y}{dx^2}\right)^{n+1} \left(\frac{d^3y}{dx^3}\right)^2 = c_1 \dots (2).$$

Differentiating this equation and comparing with original equation, we find that $n = -\frac{1}{3}$ and $-\frac{1}{3}$.

In (2), put $n = -\frac{1}{3}$. The equation is exact and its integral is

$$\left(\frac{d^2y}{dx^2}\right)^{-\frac{2}{3}} \frac{d^3y}{dx^3} = c_1x + c_2.$$

Integrating again,

$$-\frac{3}{2} \left(\frac{d^2y}{dx^2}\right)^{-\frac{2}{3}} = \frac{c_1}{2}x^2 + c_2x + c_3.$$

Solving for d^2y/dx^2 , and changing the constants,

$$\frac{d^2y}{dx^2} = \frac{1}{(c_1x^2 + 2c_2x + c_3)^{\frac{3}{2}}}.$$

Integrating twice, we have

$$y = \frac{1}{c_1c_3 - c_2^2} \sqrt{(c_1x^2 + 2c_2x + c_3) + c_4x + c_5}.$$

Also solved by G. B. M. Zerr, and V. M. Spunar.

272. Proposed by CLARENCE OHLENDORF, Chicago, Ill.

Find $\int \log_e \tan^{-1} x dx$.

Solution by J. SCHEFFER, A. M., Hagerstown, Md., and C. N. SCHMALL, New York City.

Putting $x = \tan y$, we have

$$\int \log \tan^{-1} x dx = \int \log y \frac{dy}{\cos^2 y} = \int \log y \sec^2 y dy = \log y - \tan y - \int \frac{\tan y dy}{y}.$$